

# Multiple species use of a water-filled tree hollow by vertebrates in dry woodland habitat of northern New South Wales.

Dana Vickers<sup>1</sup>, John T. Hunter<sup>2</sup> and Wendy Hawes<sup>3</sup>

<sup>1</sup>School of Geography, Planning and Environmental Management, University of Queensland, Brisbane, Queensland, 4072

Email: danalee84@bigpond.com

<sup>2</sup>School of Behavioural, Cognitive and Social Sciences, University of New England, Armidale, New South Wales, 2350

<sup>3</sup>The Envirofactor Pty. Ltd., PO Box 626, Inverell, New South Wales 2360

## ABSTRACT

Tree hollows are a major feature within Australian habitats and an important functional resource for many species in terms of shelter, reproduction, and thermoregulation. Water-filled tree hollows, or phytotelmata, also function as a valuable resource, but their use is only scarcely documented. We used camera trapping to determine which vertebrate species were utilising a known water-holding hollow in dry woodland habitat, and assessed whether antagonistic behaviour, such as hoarding of the resource, was occurring. Camera footage was obtained over a period of three days and nights, and species' use of the hollow analysed. A total of seven vertebrates (one frog, two reptile and four mammal species) were recorded using the hollow, which included diurnal and nocturnal species. Use by the Feathertail Glider was the most frequent compared to other species. The study highlights an ecological significance of water-filled hollows that should be considered in the management of dry woodland habitats, where the availability of these resources may be depleted by land clearing and loss of existing hollow-bearing trees.

**Key words:** phytotelmata, arborealists, Five Corners, Acrobates, Petaurus, Trichosurus, Cryptoblepharus, Litoria, Varanus

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## Introduction

Tree hollows are a major feature within Australian habitats and an important functional resource used by more than 300 vertebrate species (Gibbons and Lindenmayer 2002). Much research regarding hollow-use has centred on shelter and breeding sites, and their preferred characteristics across different habitats (Rowston 1998; Crane *et al.* 2010; Beyer *et al.* 2008; Goldingay 2009). Multiple use of natural hollows has been examined in relation to co-species roosting and denning (Fleming and Frey 1984; Quin 1995; Johnstone *et al.* 2013). Other studies have looked at the role of hollow use for reproduction and thermoregulation (Webb and Shine 1997; Reynolds 2005; Bryant *et al.* 2012).

Water-filled hollows, or phytotelmata, are recognised as a valuable resource for fauna (Gibbons and Lindenmayer 2002). Their use has been documented for several species worldwide (Kitching 1969; Kitching and Callaghan 1982; Yanoviak 2001; Gibbons and Lindenmayer 2002), and their ecology closely examined (Jenkins and Kitching 1990; Walker *et al.* 1991; Fincke 1998; Kitching 2000; Schmidl *et al.* 2008). However, utilisation of water-filled hollows by vertebrate species within the Australian context, remains understudied.

Direct observation of phytotelmata within natural habitat is not straightforward. Success depends not only on knowing where hollows are located, but also on whether

or not a particular hollow is holding water. In old growth trees, water may be held in cavities beyond view of the naked eye, making observation difficult. Furthermore, use of water-holding hollows may occur at any time of the day and across many months, requiring long periods of observation. Methods which reduce the need for physical presence of the observer, but provide information over an extended period of time, would be advantageous.

Camera traps allow for extended periods of observation across a range of habitats, with minimal disturbance caused by light, noise or human activity (Marnewick *et al.* 2008; Kucera and Barnett 2011). Consequently, this technique held promise for studying use of water-holding hollows by fauna. In this study we tested the application of camera trapping at a known water-filled tree hollow, to determine which species used the hollow, and whether simultaneous use of the hollow by different species within dry woodland habitat occurred. We also assessed whether there was antagonistic behaviour, such as hoarding or aggression, among species.

## Methods

The study area was located at *Five Corners*, a 240 ha property with a Voluntary Conservation Agreement under the National Parks and Wildlife Act 1974. *Five Corners* (Lat 29.611°S Long 151.212°E) occurs on the northwest

slopes of northern New South Wales 25 km north east of Inverell. Mean annual rainfall is approximately 800 mm but variable, with frequent thunderstorms during summer making significant contribution to rainfall totals (Bureau of Meteorology 2013). At the time of the study *Five Corners* was in drought, with record high summer temperatures (Bureau of Meteorology 2014).

The vegetation at the study location was grassy box woodland variously dominated by Yellow Box *Eucalyptus melliodora*, White Box *E. albens*, Grey Box *E. moluccana*, and Narrow-leaved Ironbark *E. crebra*, in association with Blakely's Red Gum *E. blakelyi*, Tumbledown Red Gum *E. dealbata*, Orange Gum *E. prava*, Caley's Ironbark *E. caleyi* and Mugga Ironbark *E. sideroxylon* (Hunter 2014). Despite impacts of past clearing, stands of remnant old growth and individual old growth trees remain, with several vegetation communities containing trees with hollows.

A 10.0 megapixel MOULTRIE 'No Glow' Digital Game Camera with 940nm infrared LED illumination was used to monitor a tree, where spotlighting observations of glider activity had previously indicated a den site or phytotelmata (Vickers 2014). Confirmation of water within the hollow was made by assessment of the tree during daylight hours. The hollow was located between the forked main branches of a Narrow-leaved Ironbark (30.5 cm diameter at breast height [dbh]), with an elongated and upward-facing diameter (<10 cm), opening into a chamber below (Fig 1). The restrictive nature of the hollow's location meant we were unable to determine the depth of water contained inside.

The camera was placed approximately 3 m above the ground on a nearby tree facing the hollow (Fig 1). Video duration was set at 20 seconds following motion detection, with a reset delay between recordings of 5

seconds. Recordings were made for three days and nights from 2<sup>nd</sup> February 2014 to 5<sup>th</sup> February 2014. During recording, the time, ambient temperature, and intensity of moonlight were recorded, to identify environmental conditions in which activity took place.

## Results

Eleven minutes and 40 seconds of footage contained animal activity. Seven species were recorded visiting the hollow. Marsupials included three gliders; the Sugar Glider *Petaurus breviceps*, Squirrel Glider *P. norfolcensis*, and a species of Feathertail Glider *Acrobates* sp.. Two species of Feathertail Glider have recently been recognised (Aplin, 2013), both of which potentially occur in the study region, but we were not able to determine which species was observed. Other marsupial observations included a Common Brushtail Possum *Trichosurus vulpecula*. Reptiles recorded included; the Fence Skink *Cryptoblepharus* sp., and Lace Monitor *Varanus varius*. An amphibian, Peron's Tree Frog *Litoria peronii*, was also recorded (Fig 2 and 3; Table 1).

Only reptiles were recorded visiting the hollow during daylight hours, with all other observations occurring at night. A single recording showed the simultaneous presence of two different species at the hollow; Peron's Tree Frog and the Feathertail Glider. The most frequent visitor to either enter or exit the hollow was the Feathertail Glider (Fig 2). Although it was impossible to determine the number of Feathertail Gliders present, several recordings show at least two individuals. Physical interaction between individuals did occur, although this did not appear to prevent access to the resource.

Ninety-five percent of Feathertail Glider activity took place when ambient air temperature was <20°C (Table 1). Nocturnal activity for all other recorded marsupials



**Figure 1.** Camera trap set up: the arrow points to the hollow entrance above where the main trunk branches into two stems. A bulge below the hollow entrance and the presence of sealed fissures where the stems have grown provide clues to its water-holding capacity.

**Table 1.** Time log for species visitations to water-holding tree hollow.

Category: nocturnal species (N); diurnal species (D).

Hollow activity: entering (ent); exiting (ex); surrounding hollow (sr); stationary at hollow (st).

Body entry: partial body entry (p); whole body entry (w).

Date	Time (24hr)	Species	Category (Nocturnal /Diurnal)	Temperature (°C)	Hollow activity	No. individuals observed	Body entry
2/2/2014	4:52:00	<i>Acrobates</i> sp.	N	12	ent	2	w
2/2/2014	5:09:00	<i>Acrobates</i> sp.	N	12	ent	1	w
2/2/2014	11:46:00	<i>Cryptoblepharus</i> sp.	D	30	ent	1	w
2/2/2014	13:38:00	<i>Varanus varanid</i>	D	31	ent	1	w
2/2/2014	13:48:00	<i>Varanus varanid</i>	D	31	ex	1	w
2/2/2014	20:52:00	<i>Litoria peronii</i>	N	22	ent	1	w
2/2/2014	21:06:00	<i>Litoria peronii</i>	N	22	ent	1	w
2/2/2014	21:54:00	<i>Litoria peronii</i>	N	20	st	1	-
2/2/2014	21:58:00	<i>Litoria peronii</i>	N	20	ent	1	w
2/2/2014	21:58:00	<i>Acrobates</i> sp.	N	20	sr	1	-
2/2/2014	23:05:00	<i>Petaurus breviceps</i>	N	18	ent/ex	1	p
2/2/2014	23:45:00	<i>Acrobates</i> sp.	N	17	sr	1	-
3/2/2014	01:01:00	<i>Acrobates</i> sp.	N	16	ent	1	w
3/2/2014	01:19:00	<i>Acrobates</i> sp.	N	16	ent/sr	2	w/-
3/2/2014	01:51:00	<i>Acrobates</i> sp.	N	15	ex/ent/sr	2	w/-
3/2/2014	01:52:00	<i>Acrobates</i> sp.	N	16	sr/ent	2	w/-
3/2/2014	01:55:00	<i>Acrobates</i> sp.	N	16	sr/ent	1	w
3/2/2014	02:02:00	<i>Acrobates</i> sp.	N	16	sr/ent	1	w
3/2/2014	02:03:00	<i>Acrobates</i> sp.	N	17	sr/ent	1	w
3/2/2014	04:26:00	<i>Acrobates</i> sp.	N	13	ent/ex	1	w
3/2/2014	04:29:00	<i>Acrobates</i> sp.	N	14	sr/ent	1	w
3/2/2014	04:30:00	<i>Acrobates</i> sp.	N	14	sr	1	-
3/2/2014	04:34:00	<i>Acrobates</i> sp.	N	16	sr/ent	1	w
3/2/2014	21:12:00	<i>Litoria peronii</i>	N	21	st	1	-
3/2/2014	21:35:00	<i>Litoria peronii</i>	N	20	ent	1	w
3/2/2014	22:41:00	<i>Acrobates</i> sp.	N	19	sr	1	-
3/2/2014	22:51:00	<i>Acrobates</i> sp.	N	19	sr	1	-
4/2/2014	00:34:00	<i>Acrobates</i> sp.	N	16	sr	1	-
4/2/2014	01:33:00	<i>Trichosurus vulpecula</i>	N	15	sr	1	-
4/2/2014	01:35:00	<i>Trichosurus vulpecula</i>	N	16	st	1	-
4/2/2014	01:41:00	<i>Trichosurus vulpecula</i>	N	17	sr	1	-
4/2/2014	02:19:00	<i>Acrobates</i> sp.	N	16	sr	1	-
4/2/2014	03:03:00	<i>Acrobates</i> sp.	N	15	sr/ent	1	w
4/2/2014	04:12:00	<i>Trichosurus vulpecula</i>	N	13	sr	1	-
4/2/2014	04:15:00	<i>Petaurus norfolcensis</i>	N	14	st	1	-
4/2/2014	04:17:00	<i>Petaurus norfolcensis</i>	N	15	ent	1	p
4/2/2014	04:26:00	<i>Petaurus norfolcensis</i>	N	14	sr	1	-
4/2/2014	04:45:00	<i>Acrobates</i> sp.	N	14	sr	1	-



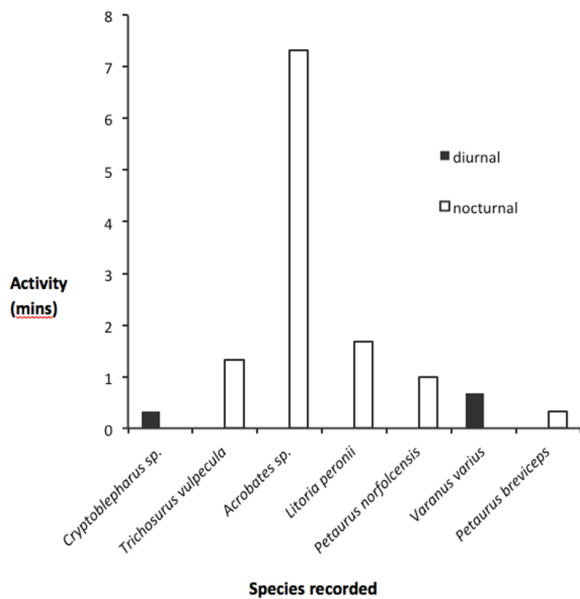


Figure 2: Recorded activity during camera trapping.

occurred within the range of 13°C and 18°C. Only Peron's Tree Frog was recorded when ambient air temperature was 20°C and above. Sixty-five percent of marsupial use of the hollow took place when temperatures were at or below 16°C, with 74% of nocturnal recordings made between the hours of 12:00am and 6:00am (Table 1). For all nocturnal recordings the moon was slight and approaching first quarter.

## Discussion

The results show that in woodlands of the north-western slopes, water-filled tree hollows are visited by multiple species during dry conditions. This is consistent with water-filled hollows being a known valuable resource elsewhere

(Gibbons and Lindenmayer 2002), and there being a limited supply of terrestrial water sources on the study area.

In woodland habitats, emphasis is placed on the importance of conserving tree hollows as shelter and nesting resources. However, variation in rainfall and frequent drought in these areas means water-filled hollows may be equally important to long-term species' survival. This has implications in dry landscapes subject to clearing, where replacement habitat for hollow-utilising fauna is often provided only by artificial den boxes. It may be as important to include additional water resources above ground, which have potentially been lost to the landscape through destruction of hollow-bearing trees by clearing.

Camera trapping to monitor a water-holding hollow in dry woodland habitat offered considerable potential for examining shared resource use by vertebrate species. The wide range of native fauna shown to use the resource over a relatively short time period indicates that the importance, and natural distribution, of phytotelmata within the landscape may be undervalued within the Australian context. As unique ecosystems in their own right, phytotelmata may become progressively more important to the survival of species in areas subject to increasingly frequent and severe droughts, as a result of predicted climate change.

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Figure 3. Recorded species during camera trapping: (a) Feathertail Glider *Acrobates* sp.; (b) Peron's Tree Frog *Litoria peronii*; (c) Sugar Glider *Petaurus breviceps*; (d) Lace Monitor *Varanus varius*; (e) Common Brushtail Possum *Trichosurus vulpecula*; (f) Fence Skink *Cryptoblepharus* sp.; (g) Squirrel Glider *Petaurus norfolcensis*.

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